In this technological age, mathematics is more important than ever. When students leave school, they are more and more likely to use mathematics in their work and everyday lives — operating computer equipment, planning timelines and schedules, reading and interpreting data, comparing prices, managing personal finances, and completing other problem-solving tasks. What they learn in mathematics and how they learn it will provide an excellent preparation for a challenging and ever-changing future.

The state of Indiana has established the following mathematics standards to make clear to teachers, students, and parents what knowledge, understanding, and skills students should acquire in Grade 4:

Standard 1 — Number Sense

Understanding the number system is the basis of mathematics. Students extend their understanding of the place value system to count, read, and write whole numbers up to 1,000,000 and decimals to two places. They order and compare whole numbers using the correct symbols for greater than and less than. They extend the concept of fractions to mixed numbers, learning how fractions are related to whole numbers. They also extend their skills with decimals and how they relate to fractions.

Standard 2 — Computation

Fluency in computation is essential. As students learn about numbers, they also learn how to add, subtract, multiply, and divide them. They understand the special roles of 0 and 1 in multiplication and division. They also add and subtract fractions and decimals, learning how these different representations of numbers can be manipulated.

Standard 3 — Algebra and Functions

Algebra is a language of patterns, rules, and symbols. Students at this level develop an understanding of the fundamental concept of a variable — having a letter represent all numbers of a certain kind. They use this to write formulas and equations, including equations that give the rule for a function. They continue number patterns involving multiplication and division. They recognize and apply the relationships among the four operations of addition, subtraction, multiplication, and division. They further develop the connection between numbers and number lines, including estimating positions on a number line.

Standard 4 — Geometry

Students learn about geometric shapes and develop a sense of space. They identify, describe, and draw such concepts as acute angles and parallel lines. They describe shapes and objects, including special quadrilaterals such as rhombuses and trapezoids. They identify congruent quadrilaterals and explain their reasoning using specific geometric terms. They draw lines of symmetry for various polygons, and they construct cubes and prisms, developing their ability to work in three dimensions.

Standard 5 — Measurement

The study of measurement is essential because of its uses in many aspects of everyday life. Students measure length to the nearest eighth-inch and millimeter and subtract units of length. They develop and use the formulas for calculating perimeters and areas of rectangles. They compare the concepts of volume and capacity. They add time intervals and calculate the amount of change from a purchase.

Standard 6 — Data Analysis and Probability

Data are all around us — in newspapers and magazines, in television news and commercials, in quality control for manufacturing — and students need to learn how to understand data. At this level, they represent data on a number line and in frequency tables, interpret data graphs to answer questions, and summarize the results of probability experiments in an organized way.

Standard 7 — Problem Solving

In a general sense, mathematics is problem solving. In all mathematics, students use problem-solving skills: they choose how to approach a problem, they explain their reasoning, and they check their results. As they develop their skills with numbers, geometry, or measurement, for example, students move from simple ideas to more complex ones by taking logical steps that build a better understanding of mathematics.

As part of their instruction and assessment, students should also develop the following learning skills by Grade 12 that are woven throughout the mathematics standards:

Communication

The ability to read, write, listen, ask questions, think, and communicate about math will develop and deepen students' understanding of mathematical concepts. Students should read text, data, tables, and graphs with comprehension and understanding. Their writing should be detailed and coherent, and they should use correct mathematical vocabulary. Students should write to explain answers, justify mathematical reasoning, and describe problem-solving strategies.

Reasoning and Proof

Mathematics is developed by using known ideas and concepts to develop others. Repeated addition becomes multiplication. Multiplication of numbers less than ten can be extended to numbers less than one hundred and then to the entire number system. Knowing how to find the area of a right triangle extends to all right triangles. Extending patterns, finding even numbers, developing formulas, and proving the Pythagorean Theorem are all examples of mathematical reasoning. Students should learn to observe, generalize, make assumptions from known information, and test their assumptions.

Representation

The language of mathematics is expressed in words, symbols, formulas, equations, graphs, and data displays. The concept of one-fourth may be described as a quarter, ¼, one divided by four, 0.25, ⅛ + ⅛, 25 percent, or an appropriately shaded portion of a pie graph. Higher-level mathematics involves the use of more powerful representations: exponents, logarithms, π, unknowns, statistical representation, algebraic and geometric expressions. Mathematical operations are expressed as representations: +, =, divide, square. Representations are dynamic tools for solving problems and communicating and expressing mathematical ideas and concepts.

Connections

Connecting mathematical concepts includes linking new ideas to related ideas learned previously, helping students to see mathematics as a unified body of knowledge whose concepts build upon each other. Major emphasis should be given to ideas and concepts across mathematical content areas that help students see that mathematics is a web of closely connected ideas (algebra, geometry, the entire number system). Mathematics is also the common language of many other disciplines (science, technology, finance, social science, geography) and students should learn mathematical concepts used in those disciplines. Finally, students should connect their mathematical learning to appropriate real-world contexts.

Standard 1

Number Sense

Students understand the place value of whole numbers and decimals to two decimal places and how whole numbers and decimals relate to simple fractions.*

4.1.1 Read and write whole numbers up to 1,000,000.

Example: Read aloud the number 394,734.

4.1.2 Identify and write whole numbers up to 1,000,000, given a place-value model.

Example: Write the number that has 2 hundred thousands, 7 ten thousands, 4 thousands, 8 hundreds, 6 tens, and 2 ones.

4.1.3 Round whole numbers up to 10,000 to the nearest ten, hundred, and thousand.

Example: Is 7,683 closer to 7,600 or 7,700? Explain your answer.

4.1.4 Order and compare whole numbers using symbols for "less than" (<), "equal to" (=), and "greater than" (>).

Example: Put the correct symbol in 328 __ 142.

4.1.5 Rename and rewrite whole numbers as fractions.

Example: $3 = {}^{6}/_{2} = {}^{9}/_{3} = {}^{?}/_{4} = {}^{?}/_{5}$.

4.1.6 Name and write mixed numbers, using objects or pictures.

Example: You have 5 whole straws and half a straw. Write the number that represents these objects.

4.1.7 Name and write mixed numbers as improper fractions, using objects or pictures.

Example: Use a picture of 3 rectangles, each divided into 5 equal pieces, to write $2{}^{3}/_{5}$ as an improper fraction.

4.1.8 Write tenths and hundredths in decimal and fraction notations. Know the fraction and decimal equivalents for halves and fourths (e.g., $1/2 = 0.5 = 0.50$, $7/4 = 1{}^{3}/_{4} = 1.75$).

Example: Write ${}^{26}/_{100}$ and $2{}^{3}/_{4}$ as decimals.

4.1.9 Round two-place decimals to tenths or to the nearest whole number.

Example: You ran the 50-yard dash in 6.73 seconds. Round your time to the nearest tenth.

* whole number: 0, 1, 2, 3, etc.

Standard 2

Computation

Students solve problems involving addition, subtraction, multiplication, and division of whole numbers and understand the relationships among these operations. They extend their use and understanding of whole numbers to the addition and subtraction of simple fractions and decimals.

4.2.1 Understand and use standard algorithms* for addition and subtraction.

Example: 45,329 + 6,984 = ?, 36,296 − 12,075 = ?.

4.2.2 Represent as multiplication any situation involving repeated addition.

Example: Each of the 20 students in your physical education class has 3 tennis balls. Find the total number of tennis balls in the class.

4.2.3 Represent as division any situation involving the sharing of objects or the number of groups of shared objects.

Example: Divide 12 cookies equally among 4 students. Divide 12 cookies equally to find out how many people can get 4 cookies. Compare your answers and methods.

4.2.4 Demonstrate mastery of the multiplication tables for numbers between 1 and 10 and of the corresponding division facts.

Example: Know the answers to 9 × 4 and 35 ÷ 7.

4.2.5 Use a standard algorithm to multiply numbers up to 100 by numbers up to 10, using relevant properties of the number system.

Example: 67 × 3 = ?.

4.2.6 Use a standard algorithm to divide numbers up to 100 by numbers up to 10 without remainders, using relevant properties of the number system.

Example: 69 ÷ 3 = ?.

4.2.7 Understand the special properties of 0 and 1 in multiplication and division.

Example: Know that 73 × 0 = 0 and that 42 ÷ 1 = 42.

4.2.8 Add and subtract simple fractions with different denominators, using objects or pictures.

Example: Use a picture of a circle divided into 6 equal pieces to find $\frac{5}{6} - \frac{1}{3}$.

4.2.9 Add and subtract decimals (to hundredths), using objects or pictures.

Example: Use coins to help you find \$0.43 − \$0.29.

4.2.10 Use a standard algorithm to add and subtract decimals (to hundredths).

Example: 0.74 + 0.80 = ?.

4.2.11 Know and use strategies for estimating results of any whole-number computations.

Example: Your friend says that 45,329 + 6,984 = 5,213. Without solving, explain why you think the answer is wrong.

4.2.12 Use mental arithmetic to add or subtract numbers rounded to hundreds or thousands.

Example: Add 3,000 to 8,000 without using pencil and paper.

* algorithm: a step-by-step procedure for solving a problem

Standard 3

Algebra and Functions

Students use and interpret variables, mathematical symbols, and properties to write and simplify numerical expressions and sentences. They understand relationships among the operations of addition, subtraction, multiplication, and division.

4.3.1 Use letters, boxes, or other symbols to represent any number in simple expressions, equations, or inequalities (i.e., demonstrate an understanding of and the use of the concept of a variable).

Example: You read the expression "three times some number added to five" and you write "$3x + 5$." What does x represent?

4.3.2 Use and interpret formulas to answer questions about quantities and their relationships.

Example: Write the formula for the area of a rectangle in words. Now let l stand for the length, w for the width, and A for the area. Write the formula using these symbols.

4.3.3 Understand that multiplication and division are performed before addition and subtraction in expressions without parentheses.

Example: You go to a store with 90¢ and buy 3 pencils that cost 20¢ each. Write an expression for the amount of money you have left and find its value.

4.3.4 Understand that an equation such as $y = 3x + 5$ is a rule for finding a second number when a first number is given.

Example: Use the formula $y = 3x + 5$ to find the value of y when $x = 6$.

4.3.5 Continue number patterns using multiplication and division.

Example: What is the next number: 160, 80, 40, 20, …? Explain your answer.

4.3.6 Recognize and apply the relationships between addition and multiplication, between subtraction and division, and the inverse relationship between multiplication and division to solve problems.

Example: Find another way of writing $13 + 13 + 13 + 13 + 13$.

4.3.7 Relate problem situations to number sentences involving multiplication and division.

Example: You have 150 jelly beans to share among the 30 members of your class. Write a number sentence for this problem and use it to find the number of jelly beans each person will get.

4.3.8 Plot and label whole numbers on a number line up to 100. Estimate positions on the number line.

Example: Draw a number line and label it with 0, 10, 20, 30, …, 90, 100. Estimate the position of 77 on this number line.

Standard 4

Geometry

Students show an understanding of plane and solid geometric objects and use this knowledge to show relationships and solve problems.

4.4.1 Identify, describe, and draw rays, right angles, acute angles, obtuse angles, and straight angles using appropriate mathematical tools and technology.

Example: Draw two rays that meet in an obtuse angle.

4.4.2 Identify, describe, and draw parallel, perpendicular, and oblique lines using appropriate mathematical tools and technology.

Example: Use the markings on the gymnasium floor to identify two lines that are parallel. Place a jump rope across the parallel lines and identify any obtuse angles created by the jump rope and the lines.

4.4.3 Identify, describe, and draw parallelograms*, rhombuses*, and trapezoids*, using appropriate mathematical tools and technology.

Example: Use a geoboard to make a parallelogram. How do you know it is a parallelogram?

4.4.4 Identify congruent* quadrilaterals* and give reasons for congruence using sides, angles, parallels, and perpendiculars.

Example: In a collection of parallelograms, rhombuses, and trapezoids, pick out those that are the same shape and size and explain your decisions.

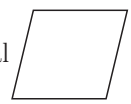
4.4.5 Identify and draw lines of symmetry in polygons.

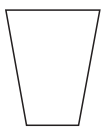
Example: Draw a rectangle and then draw all its lines of symmetry.

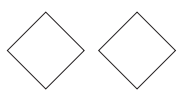
4.4.6 Construct cubes and prisms* and describe their attributes.

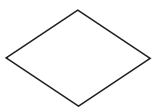
Example: Make a 6-sided prism from construction paper.

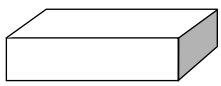
* parallelogram: a four-sided figure with both pairs of opposite sides parallel 

* rhombus: a parallelogram with all sides equal 

* trapezoid: a four-sided figure with one pair of opposite sides parallel 

* congruent: the term to describe two figures that are the same shape and size 

* quadrilateral: a two-dimensional figure with four sides 

* prism: a solid shape with fixed cross-section (a right prism is a solid shape with two parallel faces that are congruent polygons and other faces that are rectangles) 

Standard 5

Measurement

Students understand perimeter and area, as well as measuring volume, capacity, time, and money.

4.5.1 Measure length to the nearest quarter-inch, eighth-inch, and millimeter.

Example: Measure the width of a sheet of paper to the nearest millimeter.

4.5.2 Subtract units of length that may require renaming of feet to inches or meters to centimeters.

Example: The shelf was 2 feet long. Jane shortened it by 8 inches. How long is the shelf now?

4.5.3 Know and use formulas for finding the perimeters of rectangles and squares.

Example: The length of a rectangle is 4 cm and its perimeter is 20 cm. What is the width of the rectangle?

4.5.4 Know and use formulas for finding the areas of rectangles and squares.

Example: Draw a rectangle 5 inches by 3 inches. Divide it into one-inch squares and count the squares to find its area. Can you see another way to find the area? Do this with other rectangles.

4.5.5 Estimate and calculate the area of rectangular shapes using appropriate units, such as square centimeter (cm^2), square meter (m^2), square inch (in^2), or square yard (yd^2).

Example: Measure the length and width of a basketball court and find its area in suitable units.

4.5.6 Understand that rectangles with the same area can have different perimeters and that rectangles with the same perimeter can have different areas.

Example: Make a rectangle of area 12 units on a geoboard and find its perimeter. Can you make other rectangles with the same area? What are their perimeters?

4.5.7 Find areas of shapes by dividing them into basic shapes such as rectangles.

Example: Find the area of your school building.

4.5.8 Use volume and capacity as different ways of measuring the space inside a shape.

Example: Use cubes to find the volume of a fish tank and a pint jug to find its capacity.

4.5.9 Add time intervals involving hours and minutes.

Example: During the school week, you have 5 recess periods of 15 minutes. Find how long that is in hours and minutes.

4.5.10 Determine the amount of change from a purchase.

Example: You buy a chocolate bar priced at $1.75. How much change do you get if you pay for it with a five-dollar bill?

Standard 6

Data Analysis and Probability

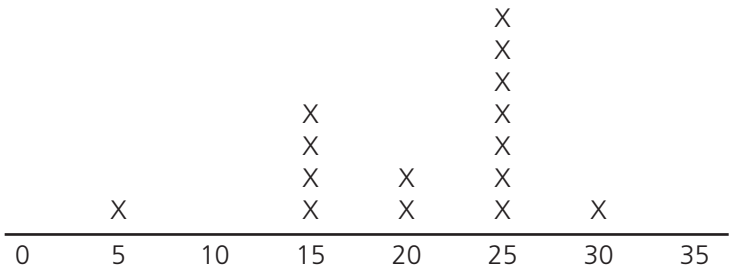
Students organize, represent, and interpret numerical and categorical data and clearly communicate their findings. They show outcomes for simple probability situations.

4.6.1 Represent data on a number line and in tables, including frequency tables.

Example: The students in your class are growing plants in various parts of the classroom. Plan a survey to measure the height of each plant in centimeters on a certain day. Record your survey results on a line plot.

4.6.2 Interpret data graphs to answer questions about a situation.

Example: The line plot below shows the heights of fast-growing plants reported by third-grade students. Describe any patterns that you can see in the data using the words "most," "few," and "none."



Plant Heights in Centimeters

4.6.3 Summarize and display the results of probability experiments in a clear and organized way.

Example: Roll a number cube 36 times and keep a tally of the number of times that 1, 2, 3, 4, 5, and 6 appear. Draw a bar graph to show your results.

Standard 7

Problem Solving

Students make decisions about how to approach problems and communicate their ideas.

4.7.1 Analyze problems by identifying relationships, telling relevant from irrelevant information, sequencing and prioritizing information, and observing patterns.

Example: Solve the problem: "Find a relationship between the number of faces, edges, and vertices of a solid shape with flat surfaces." Try two or three shapes and look for patterns.

4.7.2 Decide when and how to break a problem into simpler parts.

Example: In the first example, find what happens to cubes and rectangular solids.

Students use strategies, skills, and concepts in finding and communicating solutions to problems.

4.7.3 Apply strategies and results from simpler problems to solve more complex problems.

Example: In the first example, use your method for cubes and rectangular solids to find what happens to other prisms and to pyramids.

4.7.4 Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, tools, and models to solve problems, justify arguments, and make conjectures.

Example: In the first example, make a table to help you explain your results to another student.

4.7.5 Express solutions clearly and logically by using the appropriate mathematical terms and notation. Support solutions with evidence in both verbal and symbolic work.

Example: In the first example, explain what happens with all the shapes that you tried.

4.7.6 Recognize the relative advantages of exact and approximate solutions to problems and give answers to a specified degree of accuracy.

Example: You are telling a friend the time of a TV program. How accurate should you be: to the nearest day, hour, minute, or second?

4.7.7 Know and use appropriate methods for estimating results of whole-number computations.

Example: You buy 2 CDs for $15.95 each. The cashier tells you that will be $49.90. Does that surprise you?

4.7.8 Make precise calculations and check the validity of the results in the context of the problem.

Example: The buses you use for a school trip hold 55 people each. How many buses will you need to seat 180 people?

Students determine when a solution is complete and reasonable and move beyond a particular problem by generalizing to other situations.

4.7.9 Decide whether a solution is reasonable in the context of the original situation.

Example: In the last example, would an answer of 3.27 surprise you?

4.7.10 Note the method of finding the solution and show a conceptual understanding of the method by solving similar problems.

Example: Change the first example so that you look at shapes with curved surfaces.

NOTES